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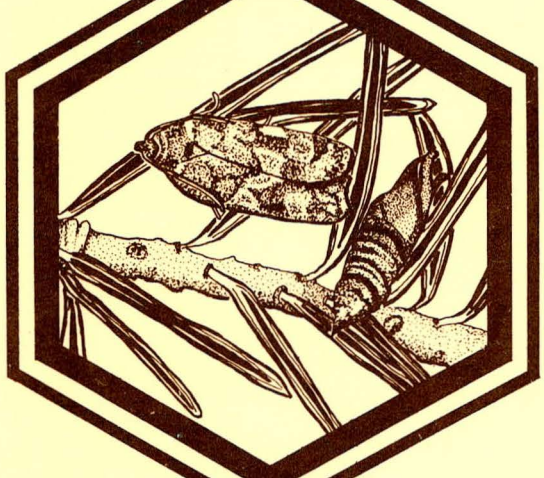

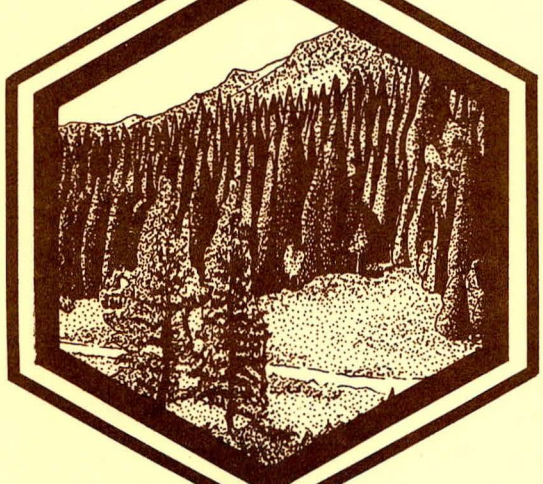

1978 DWARF MISTLETOE LOSS ASSESSMENT SURVEY BIGHORN AND SHOSHONE NATIONAL FORESTS, WYOMING

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ABSTRACT

As part of a continuing effort to assess growth loss and mortality caused by dwarf mistletoes in western coniferous forests, two systems were used to estimate annual cubic-foot volume loss in lodgepole pine due to lodgepole pine dwarf mistletoe on the Bighorn National Forest in Wyoming. The first system used data derived from Stage I timber inventory (available from Timber Management, Regional Office, Rocky Mountain Region), and the second was to conduct a road-plot survey to estimate dwarf mistletoe incidence and associated volume loss. The latter system was also used on the Shoshone National Forest. Results indicate that existing mistletoe data in timber inventory files are inadequate sources of growth loss information, and confirm results of an earlier survey. Possible reasons for this inadequacy are discussed, together with recommendations for improving the reliability of inventory data.

INTRODUCTION

During 1978, a survey was conducted on the Bighorn and Shoshone National Forests in Wyoming. Survey objectives were to test our ability to estimate green stand parameters and annual cubic-foot volume loss due to lodgepole pine dwarf mistletoe, *Arceuthobium americanum* Nutt. ex. Engelm., in lodgepole pine, *Pinus contorta* Dougl. ex. Loud, for each forest. In addition, we wished to compare (1) estimates of the incidence and intensity of lodgepole pine dwarf mistletoe computed from existing timber inventory data for the Bighorn National Forest (obtained from Stage I inventory files, 1970-71), which included a tally of dwarf mistletoe-infected trees on inventory plots (U.S. Forest Service 1976), with (2) that collected by forest pathologists using a road-plot survey.

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METHODS

Road and Plot Survey

The survey on each forest was conducted in two stages, the first a roadside reconnaissance, and the second a series of variable-radius plots located at intervals along roads through lodgepole pine stands. The specific methodology is outlined in the report by Johnson *et al.* (1978). The dwarf mistletoe rating (DMR) (Hawksworth 1977) was recorded for each plot tree.

Evaluation of Stage I Timber Inventory Data

Region 2 timber inventory data for the Bighorn National Forest were accessed to provide a summary of stand data for 167 Stage I inventory plots within lodgepole pine type. Dwarf mistletoe data included percent of lodgepole pine trees infected with the pathogen.

Determination of Volume Loss From Dwarf Mistletoe

The RMYLD simulation model (Edminster 1978) was used to estimate cubic-foot volume loss from dwarf mistletoe for the survey plot data and inventory plot data, based on the average DMR and the percent trees infected, respectively, for each plot. Loss estimates were derived by making two consecutive runs of the model, the first using the current DMR for each stand and the second with stand DMR converted to zero to represent noninfested stands. The latter simulates growth for all stands over the next 10 years as if no dwarf mistletoe infections were present.

RESULTS

Bighorn National Forest

Estimates of incidence of dwarf mistletoe on the Bighorn National Forest acquired from several sources (including timber inventory and the 1978 road-plot survey) are presented in Table 1.

Disease incidence refers to the presence or absence of dwarf mistletoe on the plot or along roads surveyed and does not reflect disease severity. Table 1 shows that 36.5 percent of the Stage I timber inventory plots contained one or more dwarf mistletoe-infected trees and 36.2 percent of the acreage represented by those plots was infested. The road survey conducted in 1978 revealed that 36.3 percent of the 174 miles traversed were adjacent to mistletoe-infested stands and 22.7 percent of the plots established in conjunction with the survey contained infected trees. A summary of the percent of miles surveyed within each size class and dwarf mistletoe infection level encountered is presented in Table 2. The greatest amount of infection was noted in the sawtimber-size class, the least in the seed-sap size class.

Table 1. Estimates of lodgepole pine dwarf mistletoe incidence on the Bighorn National Forest from several sources.

Source of data	Parameter	Percent infested
Stage I Timber Inventory (1970-71)	plots[1]	36.5
	acres[2]	36.2
1978 Road-Plot Survey	miles[3]	36.3
	plots	22.7
Hawksworth's Survey (1958)	miles	31.0

[1] Plots with at least one infected tree present

[2] Acres represented that contain infected trees

[3] Miles of road with infected trees within one chain of the right-hand side of the road

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Table 2. Percent miles of lodgepole pine type surveyed by size class and dwarf mistletoe infection level for the Bighorn National Forest 1978[1].

Stand size class	Estimate of percent trees infected with dwarf mistletoe				
	0	< 33	33-67	> 67	Total
Seed-sapling	7.2	0.7	0.2	0	8.1
Poles	33.4	8.5	3.2	2.1	47.2
Sawtimber	23.0	8.7	5.7	7.2	44.6
Totals	63.6	17.9	9.1	9.3	99.9

[1] Derived from road-plot survey

A chi-square test (Snedecor and Cochran 1967) comparing incidence of dwarf mistletoe for the Stage I inventory plots and 1978 road survey showed there was only a 5 percent chance that the difference could be attributed to sampling error. There also was no significant difference ($P \geq 0.05$) between miles of road adjacent to stands infested with mistletoe for the 1978 survey and that reported by Hawksworth (1958).

All data sources provided similar estimates of dwarf mistletoe incidence; however, a large discrepancy occurred in acreage and corresponding cubic-foot volume loss within each dwarf mistletoe severity category (Table 3). The survey conducted by forest pathologists resulted in larger acreage estimates within the higher dwarf mistletoe severity classes and a concomitant increase in total volume loss. Average annual cubic-foot volume loss per acre computed from inventory data is 0.9 compared to 2.9 for the 1978 survey. Estimated loss for pole-size and sawtimber-size stands is 1.6 and 3.9 cubic feet per acre per year, respectively.

These results indicate that while timber inventory crews were able to recognize whether or not dwarf mistletoe was present on inventory plots, as revealed by the consistency of the results on incidence of the disease in Table 1, they underestimated the intensity of the infection. This is further illustrated by the fact that 8 percent of the acreage was represented by average dwarf mistletoe ratings of 3.1 or greater for the 1978 survey plot data, while according to the timber inventory data, only 3.4 percent of the acreage contained stands that had average ratings greater than 3.1. The underestimation of disease intensity appears to be related to the use of "percent trees infected" in the RMYLD model. There are two possible sources of error when using this parameter instead of average stand DMR in the model:

1. When using percent trees infected (P), the program converts this value to an average stand DMR using the following formula:

   $$\text{Log}_{10}\ \text{DMR} = -0.8814 + 0.01492\ P$$

   When this formula is used all stands with average DMR values of 4.0 or greater would be entered as having 100 percent of the trees present infected by dwarf mistletoe. The volume loss in stands with an average stand DMR of 4.0 would be significantly less than those with an average stand DMR of 6.0, but would have identical "P" values. Data based on actual DMR is more accurate and should be used if available (Hawksworth 1977).

2. It is also more difficult to identify trees with few infections when scanning the entire tree instead of using the DMR rating system which requires that the crown of each tree be evaluated in one-third increments. The latter evaluation would require the crew to observe the crown more carefully.

Table 3. Comparison of annual cubic-foot volume loss estimates to lodgepole pine dwarf mistletoe for the Bighorn National Forest, derived from Stage I inventory and 1978 road-plot surveys.

Dwarf mistletoe severity category	Thousands of acres represented				Annual cubic-foot volume loss	
	Stage I timber inventory		1978 road-plot survey		Stage I timber inventory	1978 road-plot survey
	Plots (no.)	Acres	Plots (no.)	Acres		
0	106	167	52	199	0	0
0.1 - 1.0	49	77	4	15	84,700	0
1.1 - 2.0	3	5	2	8	3,000	26,800
2.1 - 3.0	3	5	2	8	4,600	75,800
3.1 - 4.0	3	5	1	4	37,300	34,400
4.1 - 5.0	3	4	2	8	104,200	87,900
5.1 - 6.0	0	0	2	8	0	500,900
Totals	167	263	65	250	233,800	725,800

The probability that both causes discussed above are contributing to the difference in loss estimates is high. The fact that there were no plots from inventory with average DMR values of 5.0 or greater suggests that the use of "percent trees infected" should be avoided, while the difference in the percent of the area with average DMR values of 3.1 and greater (8 percent for road-plot survey and 3.4 percent for inventory on the Bighorn) suggests that the crews may be missing some trees with infections.

Shoshone National Forest

The road survey conducted in 1978 revealed that 64 percent of the 78 miles traversed through lodgepole pine type were adjacent to mistletoe-infested stands (Table 4) and 59.4 percent of the plots established in conjunction with the survey contained mistletoe-infected trees. The greatest amount of infection was noted in the pole-sized class stands.

An estimate of the annual cubic-foot volume loss for the forest is presented in Table 5. Average annual loss per acre is estimated at 5.1 cubic feet. Estimated loss for pole-size and sawtimber-size stands is 3.5 and 5.8 cubic feet per acre per year, respectively.

DISCUSSION AND CONCLUSIONS

The results of the 1978 road-plot survey, when compared to those derived from timber inventory, indicate that dwarf mistletoe data currently in inventory files are inadequate for estimating volume loss. This same conclusion was reached when estimates for the Medicine Bow National Forest were generated in 1978 (Johnson et al. 1978); however, no discussion of possible causes of the discrepancy between the various estimates was presented.

In order to reduce the problems associated with the use of inventory data, it is recommended that timber inventory and insect and disease specialists cooperate to improve inventory systems that will provide more reliable estimates of losses to forest pests. Also, a study should be initiated to compare estimates of dwarf mistletoe infection derived from "percent trees infected" to that derived from use of the DMR system.

Table 4. Percent of miles of lodgepole pine type surveyed by size class and dwarf mistletoe infection level for the Shoshone National Forest 1978[1].

Stand size class	Estimate of percent of trees infected with dwarf mistletoe				
	0	< 33	33-67	> 67	Total
Seed-sapling	8.9	4.5	0.3	0	14.5
Poles	16.7	9.5	16.2	10.5	52.9
Sawtimber	10.3	1.7	3.2	17.2	32.4
Totals	35.9	15.7	19.7	28.5	99.8

[1] Derived from road-plot survey

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Table 5. Estimate of cubic-foot volume loss due to lodgepole pine dwarf mistletoe for the Shoshone National Forest derived from the 1978 road-plot survey.

Dwarf mistletoe severity category	Plots (no.)	Thousands of acres represented	Annual cubic-foot volume loss
0	15	55	0
0.1 - 1.0	2	7	0
1.1 - 2.0	4	15	0
2.1 - 3.0	4	15	47,500
3.1 - 4.0	7	26	215,800
4.1 - 5.0	3	11	139,000
5.1 - 6.0	2	7	296,200
Totals	37	136	698,500

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